



City/ County Association of
Governments of San Mateo County

HYDROGEN HIGHWAY

Air Resources Board California Hydrogen
Highway Network Workshop

Sacramento, California
October 28, 2005

COUNTYWIDE VIEW

- Multiple Stations to Cover County
- Multiple Technologies
- Public Private Sector Partnership
- Renewable Energy Components
- Established Technology

C/CAG HYDROGEN HIGHWAY

San Mateo County

- Three Stations in San Mateo County
- 10-15 Mile Spacing
- Within 2 Miles of Highway 101 (Peninsula Backbone)
- Renewable Energy Sources - Bio-Diesel and Solar to Offset Electricity Usage of Menlo Park Station
- C/CAG Support All Stations and Actively Participating in Menlo Park Station Development



C/CAG Hydrogen Highway

San Mateo County

Proton's Commercial PEM Electrolyzer



- Electricity + Water = H₂ Fuel + O₂ (vented to air)
- 12 kg H₂ per day High Purity H₂ Fuel
- Zero (or Reduced) Emissions when Renewable Electricity Sources are used

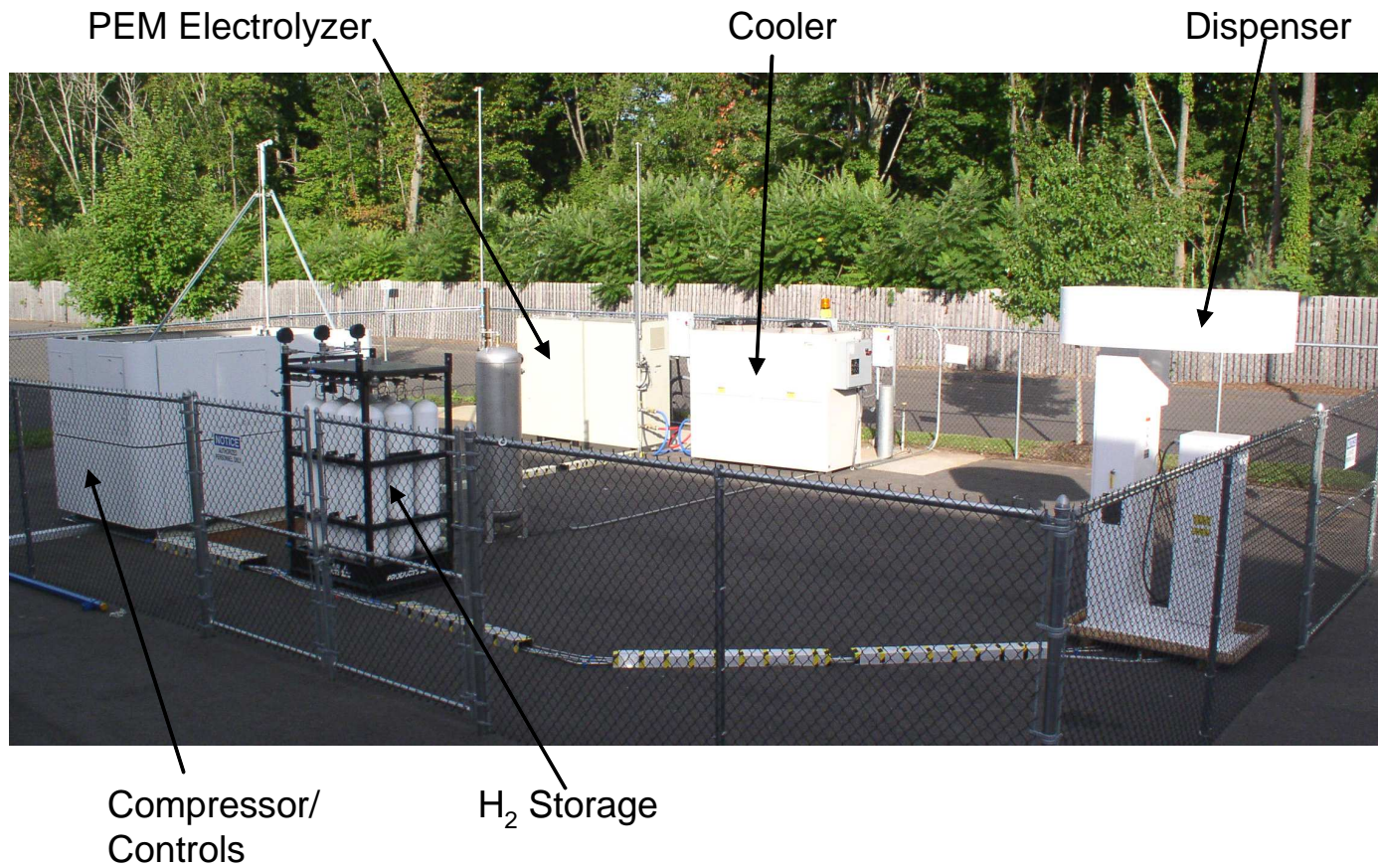
- Automated Operation
- Remote Monitoring
- Low Maintenance
- Easy Installation
- 99.999+% Gas Purity



3 Cell Stacks

PEM Electrolysis Fueling Station

H₂ Fueling Station Operating in Wallingford, CT



**Linde is a global player
in the industrial gases and engineering industry.**

Linde Gas

Linde

Hydrogen Offerings:

Linde delivers every piece of the hydrogen value chain from production, liquefaction, storage, distribution, and delivery.

Operations:

Linde has 40,000 employees worldwide, 2,500 people in the U.S., and \$11 billion in sales worldwide.

126 years of innovation:

Founded in 1879 in Germany -
Founded 1907 in the U.S.

U.S. Hydrogen Highway Office:

Esquire Plaza, Sacramento,
California

Hydrogen Production:

Linde believes in combination of different hydrogen production systems including:
centralized and/or on-site hydrogen production,
production using steam reformation, electrolysis, solar, wind

Linde drives America's hydrogen highways.

Linde Gas

Linde

Linde stations reflect state-of-the-art technology

- space efficiency
- customized underground installation
- professional, ergonomic design
- usability of filling equipment

Linde fueling and dispensing capabilities are:

- up to 10,000 psi (doubling vehicle ranges)
- fast-fill technology allows users to fuel up under 2 minutes

Linde's ionic compressor compresses hydrogen isothermal and contamination-free.

- High energy efficiency
- 10,000 hour maintenance intervals
- No risk of contaminating hydrogen with lubricating oil or mechanical impurities
- No undesired heat generation

Linde built over 30 hydrogen fueling stations globally. Among them are:

- **BMW**, Oxnard, California, U.S.A.
- **Shell**, Washington D.C., U.S.A. (partially)
- **Shell**, Amsterdam, The Netherlands
- **Shell**, Ariaka, Japan
- **DaimlerChrysler**, Nabern, Germany
- **DaimlerChrysler**, Sindelfinden, Germany
- **BP**, Berlin, Germany
- **BP**, Munich, Germany
- **BP**, Porto, Portugal
- **BP**, Barcelona, Spain



San Carlos Nat Gas-to-H2 Reformer/ Fueling Demo Project

Partners:

- **Pacific Gas & Electric**

(Site, project management, utilities)



*Pacific Gas and
Electric Company*

- **ZTEK**

(Reformer technology, compressor, storage, dispenser)



- **CaFCP** (end users)

Location of site:

Approx. 20 miles south of San Francisco.

Easy access on/off Hwy 101.

PG&E Service Center

CaFCP Hydrogen Fueling Station Requirements

- System Type: Steam Reforming & PSA
- H₂ Daily Production: 30 kg
- H₂ Storage: 30 kg, 6 tubes with cascade
- Pressure Dispensed: 6250 psi max
- Filling Capability: 6 cars per day,
2 cars consecutively,
5 kg tank each,
5 min. per fill.

VEHICLE OPTIONS

- Hydrogen Fuel Cell
 - ▮ Hard to Get
- Hydrogen Blend – Hydrogen (20-30%) and Compressed Natural Gas
 - ▮ Can Convert CNG Vehicles
- Hydrogen ICE
 - ▮ Can Convert ICE
 - ▮ New ICE Vehicles

RENEWABLE ENERGY

- SB 76 Includes Renewable Energy Source
- Solar
- Bio-Diesel